Categorization in Humans

Categorization is the ability to put an object to a group based on some internal representations of the group (Rosch et al. 1976). The ability to categorize objects and events and extending this behavior to new instances is fundamental to many human activities. I sort the objects and events around us into categories, while still being able to recognize some or all of the individuals. In general, categorization could be divided into two levels (Behl-Chadha 1996). If the detected physical properties of the individuals within a category are mostly similar, we call it as basic level of abstraction (Rosch et al. 1976). For example; we could put Asians, Africans and Caucasians into one group; that is a human group. If the connection between members of one category is not only based on perceptual similarity but more on relations between concepts, we call it as abstract level of categorization (Mervis and Rosch 1975). For example, we can put rice, bread and fruit into the food or edible group and put a chair, a plane and a soap into the non-food group. Although it is basically divided into two levels, the relation between each class often overlap and sometimes it is very difficult to differentiate between classes. These levels of categorization are basic to understand language, number and social relationship with other humans. This ability obviously needs memory, learning and reasoning.

In humans, categorizing behavior was predicted to start at infantile age. Quinn (1993, 2002) found that the 3-4 month old infants attended to natural objects as though they belong to groups of basic level. The experiments used the preferential looking procedure and measure the looking time of the pictures. The infants tended to look at the picture of a new categories for longer period of time. Their ability was regarded as in the basic-level of categorization.

Categorization in Animal

The field of research on the ability of animals to categorize objects was opened by the pioneering study of Herrnstein and Loveland (1964). They showed
that the pigeon were able to sort photographs on the basis of whether the image contained human being or not. It means the pigeon were able to make a class of human and a class of non-human, which is the definition of categorization. Since then, several studies have demonstrated categorization in other animals, most of them used primates as models (ex: Tanaka 2001, Jitsumori and Matsuzawa 1991, Santos 2000). Some of the researches aimed to know whether categorization processes in the animal is based on similar processes compare to human (ex: Farbe-Thorpe 2003, Freedman et al. 2002, 2003, Hampson et al. 2004). In other case, some studies wanted to find out the levels of categorization that could be performed by the animals (ex: Tanaka 2000, Jitsumori and Matsuzawa 1991, Santos 2000, Inoue et al. 2008, Vonk & McDonald 2002; Vonk & McDonald 2004). In both cases, the studies used photos of biologically significant objects, such food vs non food, animals vs non-animals, and the last is own species vs non-own species or species discrimination (Tanaka 2001, Jitsumori and Matsuzawa 1991, Santos 2000, Inoue et al. 2008, Fujita et al 1995, 1997, Vonk & McDonald 2002; Vonk & McDonald 2004).

Species discrimination is important to prevent hybridization among species (Yoshikubo 1985, Fujita 1995, Fujita et al. 1997). Some studies were conducted to find out which part of the body are really important to identify and categorize the species. Those studies found that face provide information about species, sex, age and emotion of an individual (Pascalis and Bachevalier 1988, Tomonaga 2007). Fujita et al. (1995) demonstrated that Sulawesi macaques performed basic level of categorization in identifying their conspecific. The stimuli used in that experiment were photos of monkey presented sequentially. By counting the fixation time of each stimulus, they found that the Sulawesi macaques see their conspecific longer than non-conspecific. Thus, the photos carry specific information which could be categorized by conspecific or non-conspecific (Fujita et al. 1995, Pascalis and Bachevalier 1988, Tomonaga 2007). However, although the fixation time is easy to be described quantitatively, it is difficult to draw conclusion from it. For example, the longer reaction time could mean that monkey likes the picture in the stimuli, or it could be the opposite. In fact, in agonistic bout, the monkeys tend to
look longer to his/her opponents (de Waal et al. 1976).

Looking at previous work in primates, there are some data on categorization in great apes, *M. mulatta*, *M. fuscata* and Sulawesi macaques but not really in long-tailed macaques (*M. fascicularis*). A few studies showed that *M. fascicularis* were able to see photos as a representations of the real objects (Dasser 1987, Kyes et al. 1982). Moreover, some studies also found that those monkeys were able to identify individual within species (Dasser 1987), read facial expression from the drawing and could discriminate between drawings of some studies of old world primate species (Dittrich 1994). However, there were no direct experiment to infer the level of categorization in this species.

**Operant Conditioning Behavior**

In this experiment, I used the operant conditioning methods which refers to a process in which the frequency of occurrence of the particular type of behavior was modified by the consequences of the behavior (Reynolds 1975). In operant conditioning, the behavior (called operant) came from animal motivation to response to a given stimulus. The stimulus used in operant conditioning is discriminative. In this particular experiment, monkeys were trained to choose a specific stimulus (the plus stimulus, S+) from another alternative to get a reward. If they choose the other (the minus stimulus, S-), they would not get any rewards. The behavior to choose a specific card is an operant. The reward is the consequences of the behavior and it should increase animal motivation to choose the plus stimulus. The specific task in this operant conditioning method is matching to sample (Miller et al. 1996) with photographs of human, macaques and other animals as stimuli.